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IWT-TETRA ZonWarm: Gecombineerde zonthermie en warmtepompen in residentiële toepassingen

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Campus De Nayer, Sint-Katelijne-Waver

Project Zonwarm (SolarHeat)

- **Goal**
  - Combination of solar thermal systems and heat pumps
  - Which system concept
  - Reliable values of achievable performance

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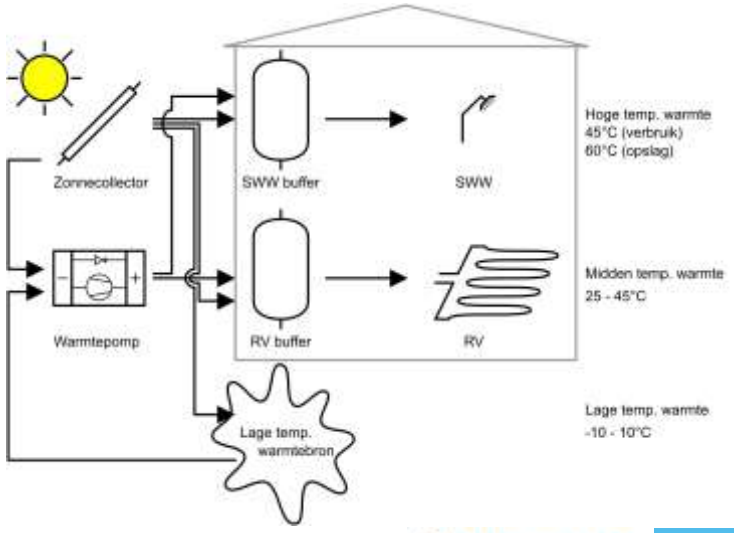
Overview



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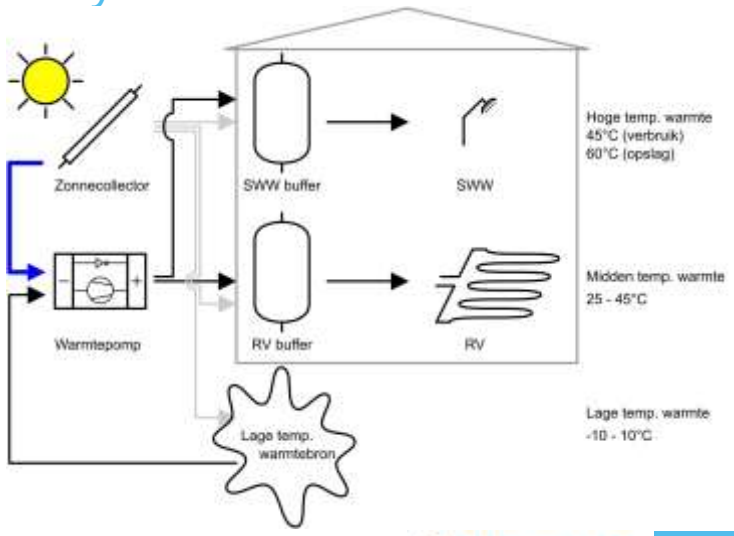
Serie-system



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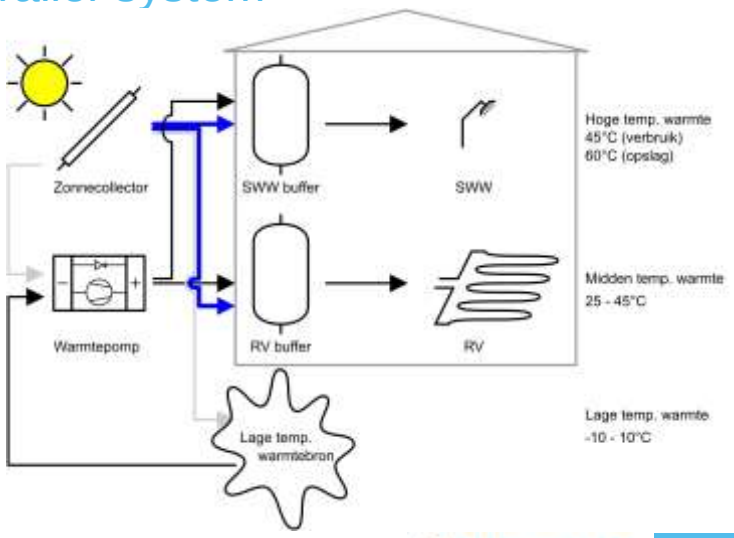
Parallel-system



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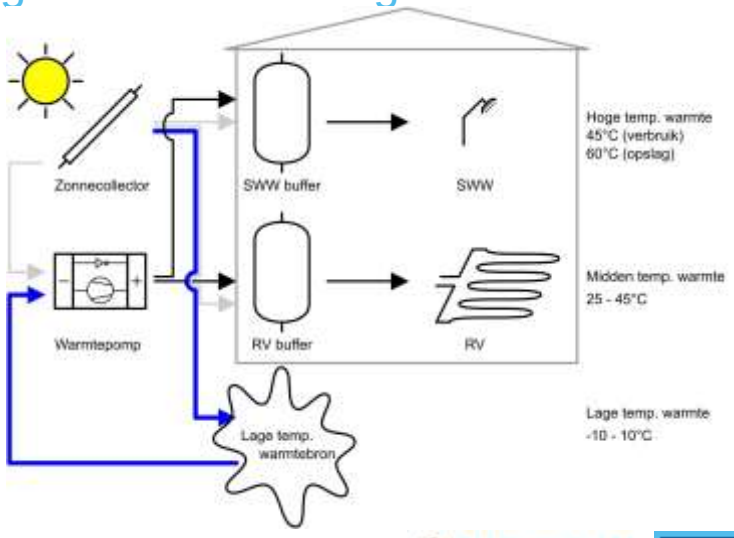
Regeneration of the ground



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Preferably solar collectors

- SPF-heat pump: 2,5 – 5
- SPF-solar collector: 40-100
  - Measured values up to 160
  - Measured values up to 7

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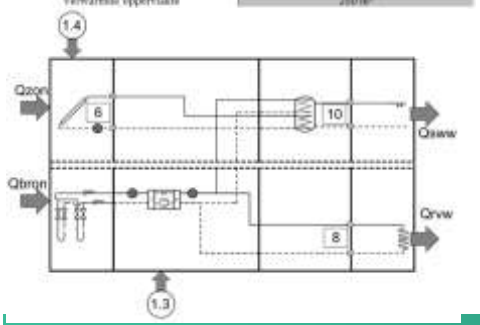
Measured systems

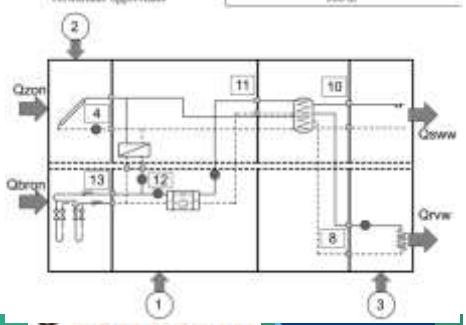
Installation 1

Warmtepomp	
Type Warmtepomp	Verticale bodemwarmtewisselaar
Vermogen Warmtepomp	10 kW (0°C/35°C)
Zonnecollectoren	
Type zonnecollector	Vlakkeplatcollector
Absorberoppervlakte	4,76 m²
Helling graad	45°
Azimuthoek	90°
Buffer	
Type buffer	Gescheiden
Volume buffervat zonkant	220 l
Volume buffervat verwarming	/
Woning	
K-peil	36
E-peil	34
Verwarmde oppervlakte	250 m²



Installation 2

Warmtepomp	
Type Warmtepomp	Verticale bodemwarmtewisselaar
Vermogen Warmtepomp	15,1 kW (0°C/35°C)
Zonnecollectoren	
Type zonnecollector	Vacuümbuiscollectoren
Absorberoppervlakte	17 m²
Helling graad	30°
Azimuthoek	135°
Buffer	
Type buffer	Gecombineerd
Volume buffervat	750 l
Woning	
K-peil	36
E-peil	47
Verwarmde oppervlakte	350 m²

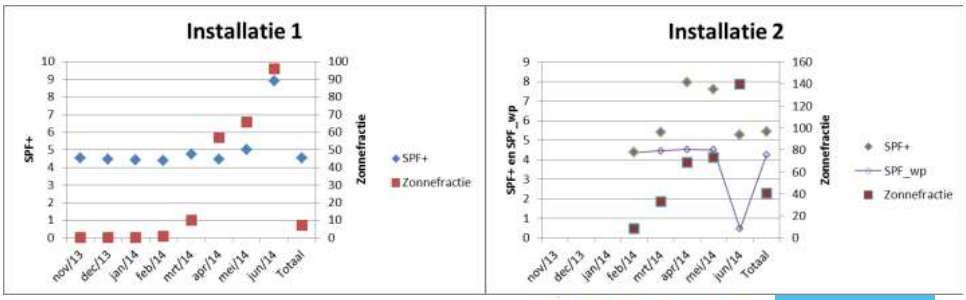


System performance

$$SPF_{HP} = \frac{Heat\ pump\ production\ (thermal)}{Heat\ pump\ consumption\ (electrical)}$$

$$SPF\ += \frac{DHW + Floorheating\ (thermal)}{Heat\ pump - total\ (incl.SH - pump)(electrical)}$$

$$f_{zon} = \frac{Solar\ collector\ production\ (thermal)}{DHW + Floorheating\ (thermal)}$$



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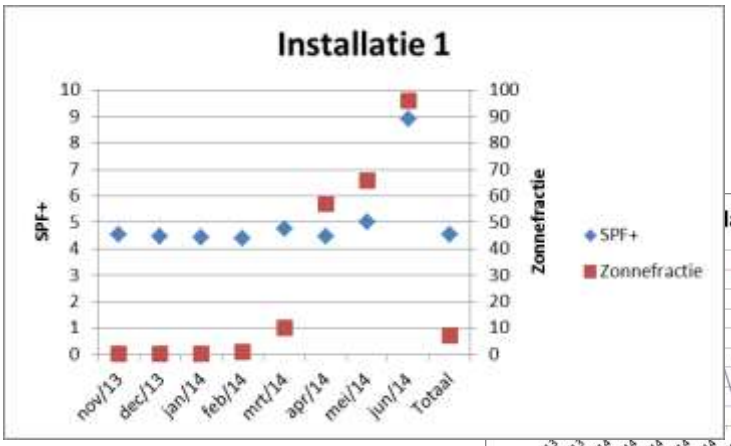
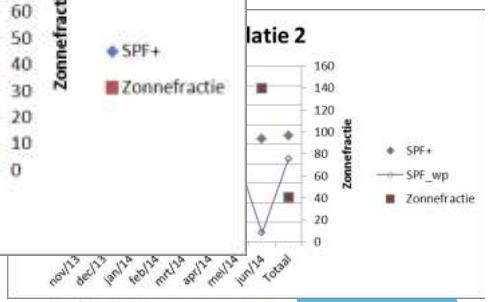
System performance





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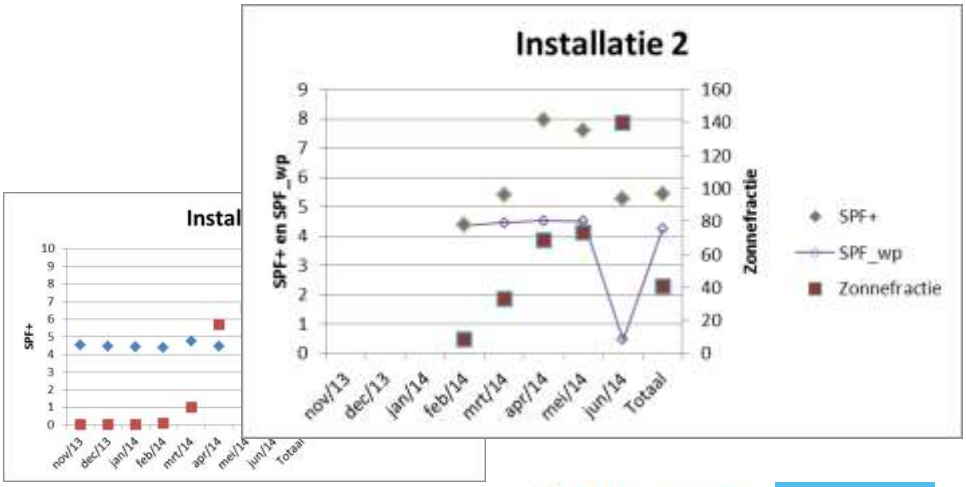
System performance



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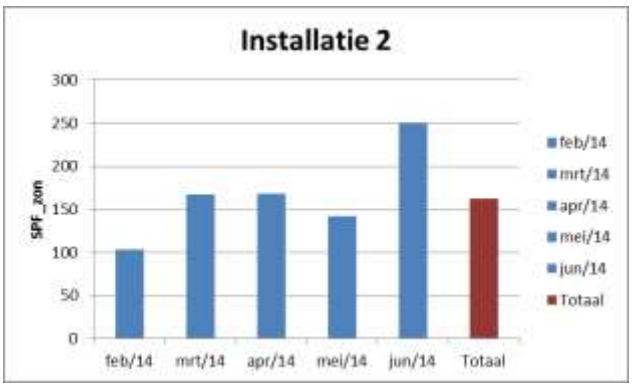
SPF solar system

$$SPF_{solar} = \frac{Solarcollector\ production\ (thermal)}{Solarcollector\ pump\ (electrical)}$$



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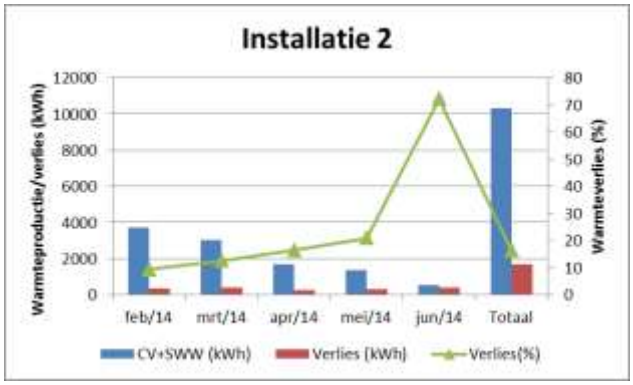
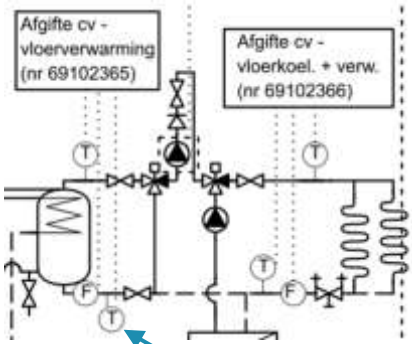
Heat loss system



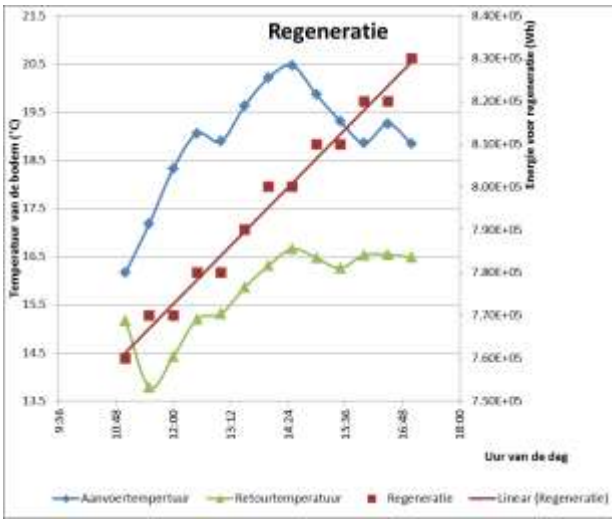
Heat loss tubing



No flow heat loss tubing storage – 3-way-valve
80 kWh/month

Regeneration

- 70kWh heat
- 1kWh E_{pomp}
- SPF = 70
- COP increases
  - How much?



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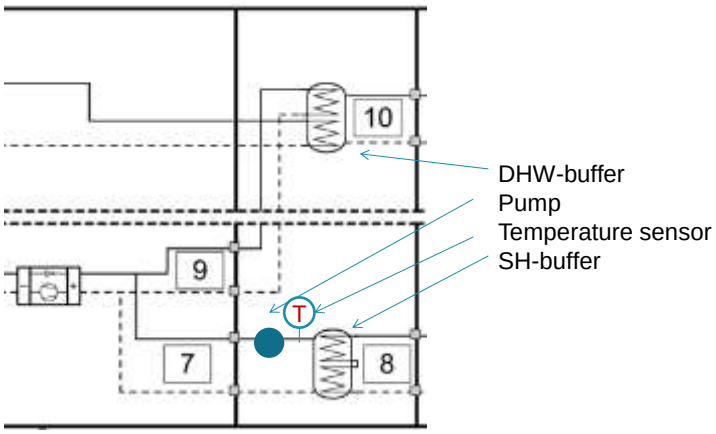
Circulation pump control SH-buffer



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Circulation pump control SH-buffer

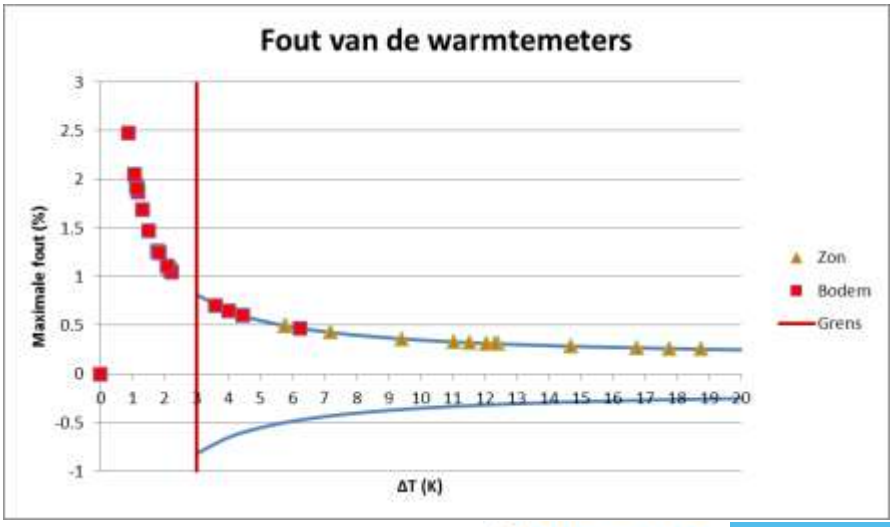
Circulation pump control SH-buffer

- Measurement data air/water heat pump adapted to leave out circulation pump electricity consumption
- Data: 1-7/4/2014

	With existing control	With adapted control
Circ. Pump electr (kWh_el)	16,3	9,4
SPF_system (-)	3,51	5,35

Average outdoor temp. (°C)	14,4
Solar radiation (kWh/m²)	21,5

Measuring heat flows



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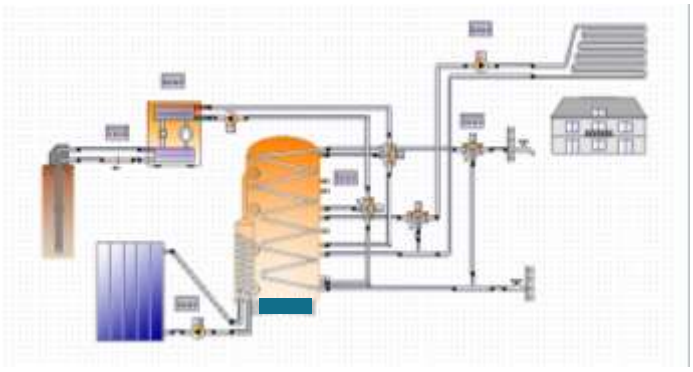
Hydraulic connections and control

- Simulation results



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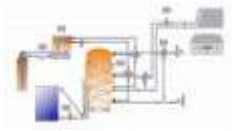
Hydraulic connections and control



- Providing buffer volume for solar thermal heat exchanger
- Correct layer-control for storge volumes
- Decreasing storage volume for DHW
- Decreasing set point for DHW (55°C-50°C)
  - DHW-comfort lower slightly (97% → 95%)

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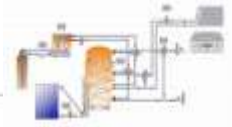
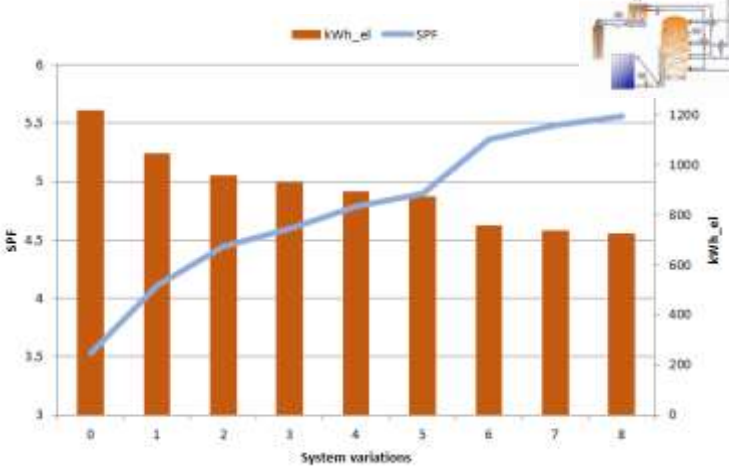
Hydraulic connections and control





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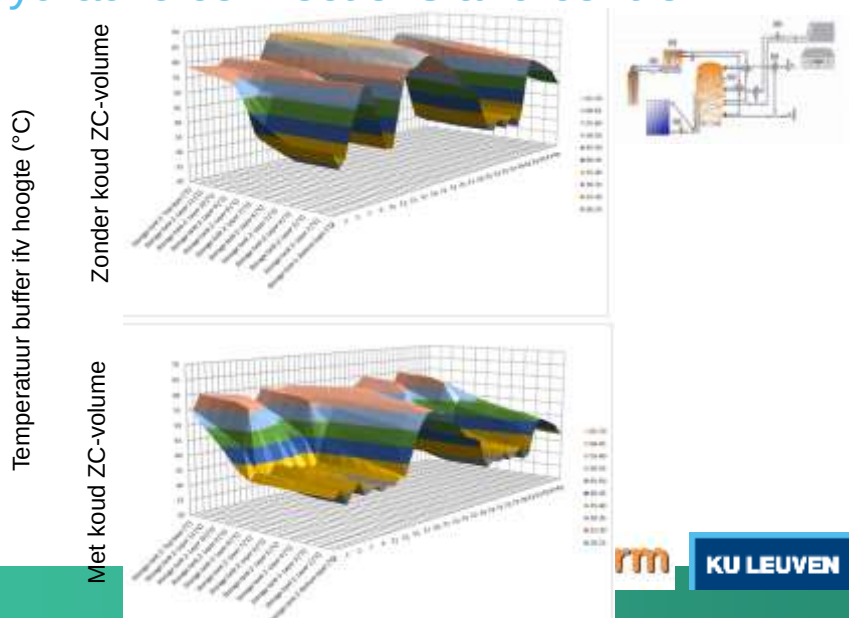
Hydraulic connections and control

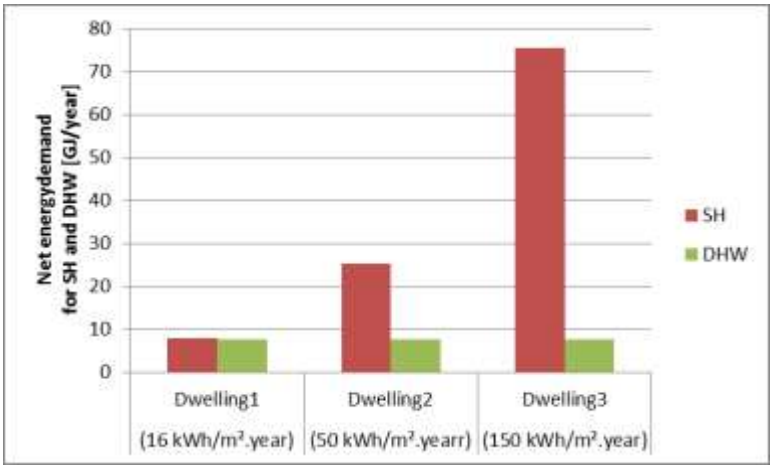


Energy performance index EPB

- With or without solar for space heating

		With			Without		
		Standaard-installaties met verwarmingsvoorziening door zonnecollectoren			Standaard-installaties zonder verwarmingsvoorziening door zonnecollectoren		
Woning	WP	E-peil	$Q_{heat,final,a}$	$Q_{water,final,a}$	E-peil	$Q_{heat,final,a}$	$Q_{water,final,a}$
SFH15	Bodem/water WP	33	6933	3111	32	7173	2701
SFH15	Lucht/water WP	35	7818	3111	34	8089	2701

Task of the installation?



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Bedankt voor jullie aandacht!

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